Model 8450/8460/8470
Velocity Transducer

Operation and Service Manual

June 1988
P/N 1980030

MP MASTER
MA35988

TSI®

TSI Incorporated

Model 8450/8460/8470

Velocity Transducer

Operation and Service Manual

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About this manual

The MODEL 8450/8460/8470 *Velocity Transducer Operation and Service Manual* explains how to install, operate, and maintain three similar models of velocity transducers. Read it thoroughly before using the instrument.

- Chapter 1 lists the enclosed components and explains how to set up and connect the velocity transducer to a power supply.
- Chapters 2 and 3 explain how to install and operate the velocity transducer.
- Chapters 4 and 5 cover maintenance and trouble-shooting procedures.
- The Appendix explains the difference between standard velocity and actual velocity.

Step-by-step instructions are numbered in boldface type:

1, 2, 3, etc., set flush-left against the text margin.

To call your attention to an important note or comment, a black four-pointed star ✦ is used.

HELP!

To obtain technical assistance with this instrument or manual, please call TSI's Industrial Test Instruments Group at 612/490-2888. If your transducer needs repair or recalibration, contact TSI's Customer Service department at 612/483-4711. ■

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Introduction

TSI's air velocity transducers are precision instruments designed to measure air mass velocity in fixed installations. Mass velocity is a measure of air velocity with reference to standard conditions of 70°F at a pressure of 14.7 psia.* The transducers require a power supply of 12 volts DC and 250 milliamperes; they are calibrated to provide a linear output of either 0 to 5 volts DC or 4 to 20 milliamperes.

The technology behind the velocity transducers is constant-temperature thermal anemometry. The velocity sensor is a heated element that is kept at a constant elevated temperature (relative to ambient temperature) by means of control electronics. As airflow past the sensor increases, more electrical power is required to maintain the sensor at the elevated temperature. Monitoring the power supplied to the sensor provides a signal that is related to the amount of air flowing past the sensor. Simultaneously, an integral temperature sensor responds to ambient temperature changes. Thus, the transducer conveniently provides a consistent indication of air mass velocity that is automatically corrected to standard conditions (70°F and 14.7 psia).

Calibration of the velocity transducers is performed in a laser-verified wind tunnel to assure a high level of accuracy at all velocities.

An optional accessory to the air velocity transducers is the MODEL 8910 Display/Power Supply. It provides power and displays air velocity readings in virtually any measurement units. ■

* TSI uses 70°F and 14.7 psia for standard conditions unless special arrangements are made when the transducer is ordered.

Chapter 1
Setup

The velocity transducer is easy to set up. First, use table 1 to make sure no parts are missing. Next, identify the five main parts of the transducer in figures 1 through 6. Then follow the instructions for connecting the instrument to electrical power.

Unpacking

The following parts are included with each transducer; if any are missing or damaged, notify TSI immediately.

TABLE 1. List of components

Qty	Item	Part No.
1	Velocity transducer	8450, 8460, or 8470
1	Connector	1302675
1	Connector cover	2919014
1	Operation and Service Manual	1980030
1	Duct-mounting plate	2601270
4	Sheet-metal screws	5096211
1	Compression fitting	2919011

Included with every manual is a registration card; look for yours at the front of this manual. Please fill it out and mail it in promptly. TSI can then inform you of updates.

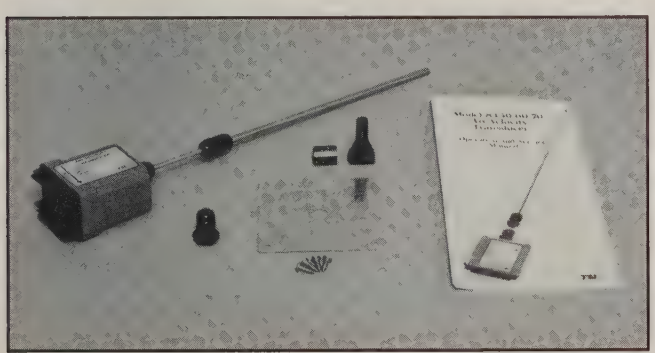

Figure 1. The velocity transducer and accessories

Identifying the parts

Figures 2 and 3 identify the main parts of the velocity transducer. Familiarize yourself with them before you continue the setup.

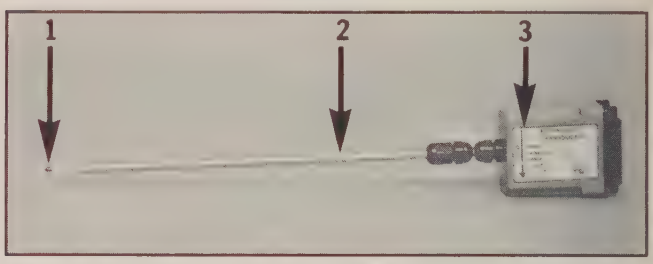

Figure 2. Side view of the transducer

1. velocity transducer probe
2. shield on Models 8460, 8470 only
3. label

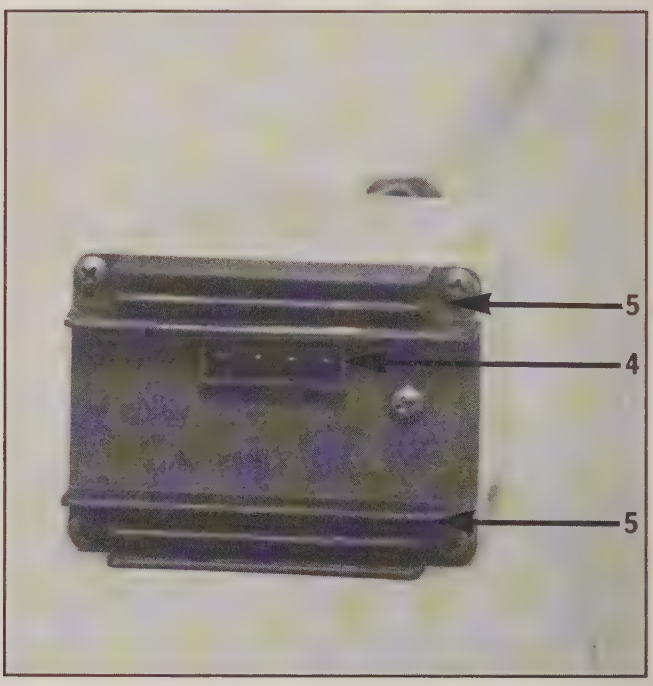

Figure 3. Back view of the transducer

4. connector
5. heatsink

Figures 4, 5, and 6 are close-ups of the probe ends for the three models of velocity transducer.

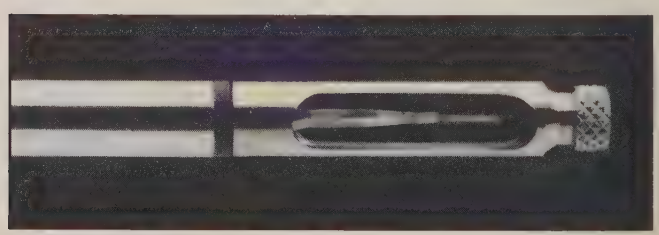

Figure 4. Probe end of the Model 8450

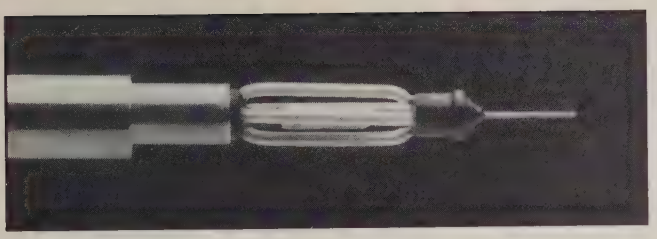

Figure 5. Probe end of the Model 8460

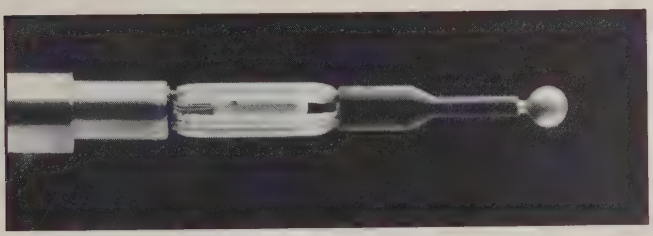

Figure 6. Probe end of the Model 8470

Connecting the transducer to power

To operate, the velocity transducer requires a power supply of +12 volts DC at 250 milliamperes. If you purchased the MODEL 8910 Display/Power Supply along with your transducer, connect them with the interconnect cable included with the power supply. The cable's hardware is the same on both ends: plug one end into the transducer and the other into the power supply.

If you purchased the transducer without the power supply, use the connector included with the transducer to terminate the interconnect cable that you must provide.

You can make up an interconnect cable for the transducer by following these six steps:

1 Use 4-conductor cable of at least 18 gauge. To help reduce noise, shielded cable is recommended for runs longer than 20 feet. Cable lengths of more than 500 feet are not recommended.

2 Unplug the connector from the back of the velocity transducer.

3 Slide the connector cover onto the cable, narrow end first (fig. 7).

4 Strip ¼-inch of insulation from the end of each wire.

5 Wire the connector according to its label. To hold the wire in the connector, insert the stripped end of the wire into the proper slot. Turn the corresponding screw clockwise until tight (fig. 8). Repeat this step until all four connections are made.

6 Slide the cover over the connector until snug (fig. 9).

Now plug one end of the connector into the back of your transducer. The other end of the cable, which you must connect to your power supply, transmits the linear signal of 0 to 5 volts DC or 4 to 20 milliamperes.

Figure 7. Connector cover in place for step 5

Figure 8. Inserting wire into the connector

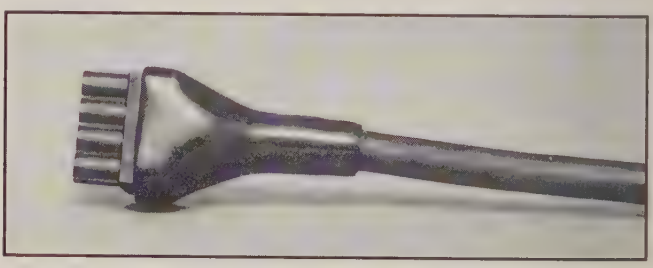

Figure 9. Assembled connector on a cable

Your velocity transducer is now ready to be installed. Proceed to chapter 2. ■

Chapter 2
Installation

The velocity transducer includes an installation kit to help you securely install the transducer. The kit fits most metal ducts. If you cannot use the kit, make sure you mount the transducer securely to avoid damaging the probe.

Installing the mounting plate

To install the mounting plate, follow these six steps:

1 Determine the desired location of the transducer in the duct.

2 Mark the spot and drill a 1-inch-diameter hole.

3 Using the galvanized mounting plate as a template, hold the plate against the duct so that the large center hole aligns with the 1-inch hole you drilled in the duct. Now drill a ⅛-inch-diameter hole at each of the four corner holes of the mounting plate (fig. 10).

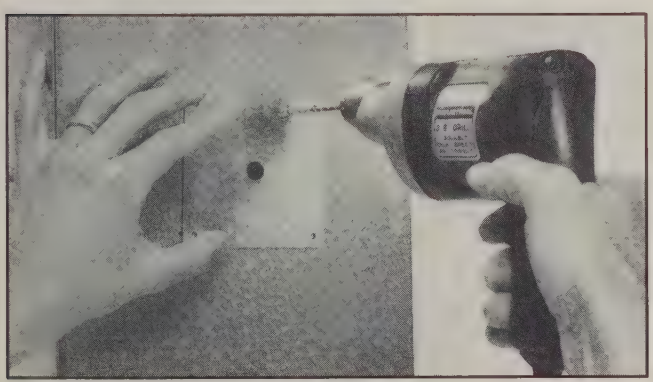

Figure 10. Drilling holes for sheet-metal screws

4 To install the plastic compression fitting on the transducer's mounting plate, first remove the ¾-inch flat nut from the back end of the fitting. Then insert the threaded end of the fitting through the center hole of the mounting plate (fig. 11). Reinstall the flat nut on the opposite side of the mounting plate and tighten firmly (fig. 12).

5 Center the plate over the 1-inch hole in the duct and hold the plate flush against the duct wall. If the duct is rectangular, simply screw the plate tightly to the duct

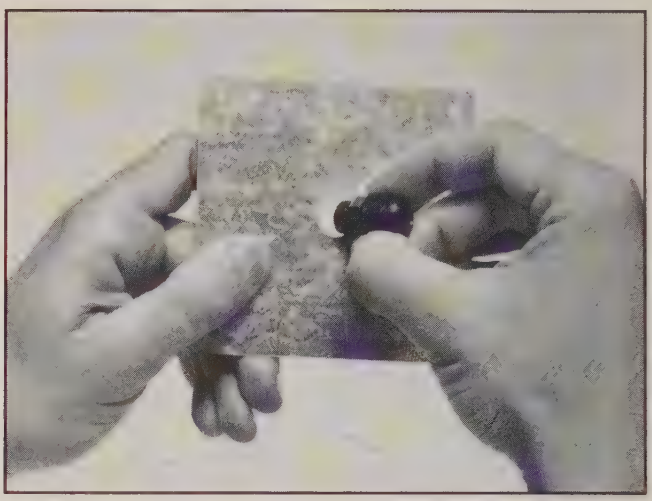

Figure 11. Inserting the compression fitting into the mounting plate

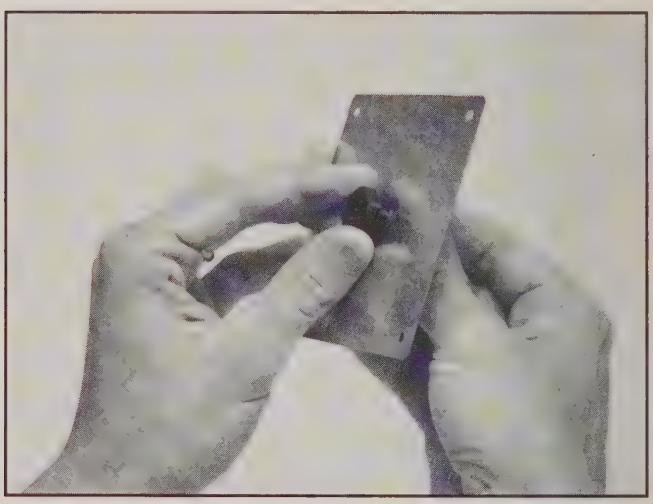

Figure 12. Reinstalling the flat nut on the opposite side of the mounting plate

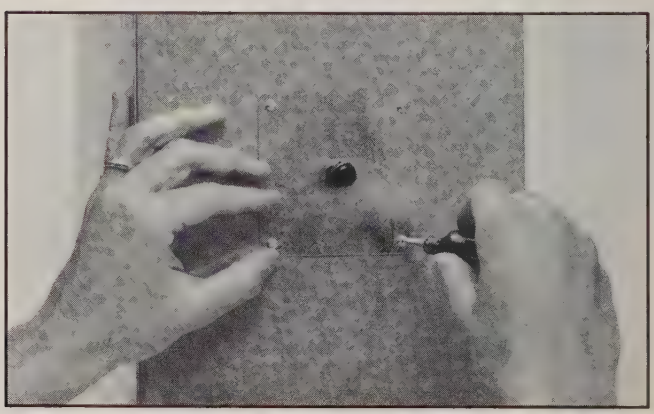

Figure 13. Installing the mounting plate to the duct

wall using the four sheet-metal screws provided (fig. 13). If the duct is round, first secure one side of the mounting plate with two of the sheet-metal screws and then bend the mounting plate to conform to the radius of the duct. Secure the other side of the mounting plate with the two remaining sheet-metal screws.

6 To seal against leaks, cover the edges of the mounting plate with duct tape.

The installation of the mounting plate is now complete.

Installing the transducer

The velocity transducers are designed to provide a high level of accuracy; each is individually calibrated. To achieve reliable, accurate results, it is essential that you mount the transducer securely and properly align it with respect to the airflow.

Once you have installed the mounting plate, follow these five steps to attach the transducer:

> *Caution:* To avoid damaging the sensor on MODELS 8460 and 8470, keep the sensor retracted in the shield as you insert it through the compression fitting.

1 Insert the probe through the compression fitting on the mounting plate (fig. 14).

- With MODELS 8460 and 8470, you must also insert the shield.

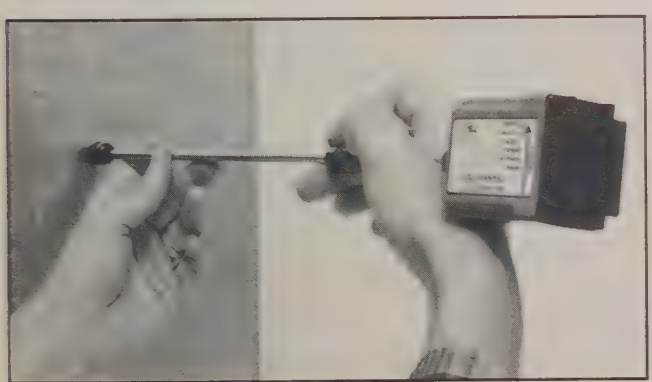

Figure 14. Inserting the probe (and shield) through the compression fitting

2 Tighten the compression fitting on the mounting plate until the transducer is secure.

3 Loosen the nut on the probe shield and push the transducer toward the mounting plate to expose the probe. (This step is not required with the MODEL 8450.)

> *Caution:* When installing the MODEL 8460 and 8470 transducers, take care not to bump, and thus damage, the tip. Since the tip extends 1⅞ inches beyond a fully retracted shield, you must keep the end of the shield more than 2 inches away from all surfaces or objects.

4 Each transducer has been calibrated in a wind tunnel, with the arrow on the label pointed in the direction of airflow. For the best results with the MODEL 8450 and 8460, rotate the probe until the arrow is parallel to, and pointing in the direction of, the airflow.

5 Hand-tighten the shield nut to secure the installed probe.

The installation of the velocity transducer is now complete. Proceed to chapter 3. ■

Chapter 3
Operation

The operation of the velocity transducers is simple.

First connect the transducer to a grounded power supply that delivers +12 volts DC; 250 milliamperes of current is required for each transducer. (To learn how to make the electrical connections, refer to chapter 1, *Connecting the transducer to power*.) Once the connections are made, the transducer is operating whenever the power supply is on.

> *Caution:* Do *not* operate the MODEL 8460 and 8470 transducers with the sensors retracted in the protective shields for more than 10 minutes. Heat may build up around the sensor and cause a permanent shift in the transducer's signal. However, operating the transducer briefly with the sensor retracted into the shield is, in fact, the recommended procedure for zero-checking these models (see ch. 5, *Troubleshooting*).

Velocity transducer output

The transducers are calibrated to provide a linear signal proportional to standard air velocity. Each model is available with an output signal of either 0 to 5 volts DC or 4 to 20 milliamperes. Zero-flow is then equal to 0 volts or 4 milliamperes, respectively; full-scale velocity is equal to 5 volts or 20 milliamperes, respectively. Refer to the label on the side of your transducer: It identifies not only the output signal provided by your transducer but also the full-scale velocity for which it is calibrated. If you operate the transducer within the full-scale velocity range, you are assured of the accuracy and performance as published in the specifications. While operating beyond full-scale will not damage the transducer, you will find that the output signal is unusable. ■

Chapter 4
Maintenance

Cleaning the sensor

Significant build-up of dust or dirt on the sensor can cause errors in velocity readings. It is recommended that you periodically inspect it to determine whether the sensor needs cleaning.

> *Caution:* To prevent damage to the sensor, be sure to switch off power to the transducer before cleaning the sensor.

If you notice an accumulation of dust or dirt, use a soft-bristled brush (such as an artist's brush) to carefully clean the sensor (fig. 15). If necessary, dip the brush in a solvent such as alcohol or trichlorethane.

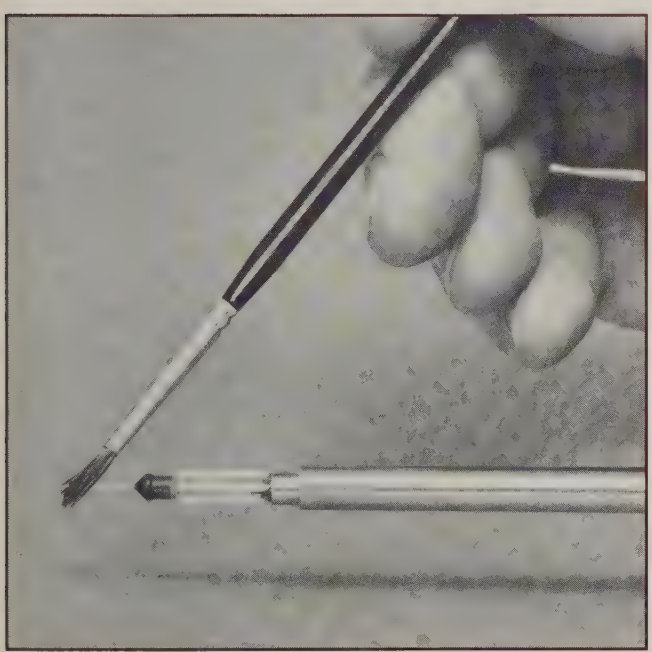

Figure 15. Cleaning the sensor

Aside from keeping the sensor clean, the velocity transducer is essentially maintenance-free. No periodic adjustments are necessary.

Replacing the sensor

This series of velocity transducers features field-replaceable sensor probes. Should you happen to critically damage or

break the sensor on your transducer, order a replacement probe from TSI or your nearest representative.

Calibrating the transducer

For all velocity transducers that see frequent use, TSI recommends annual calibration. To do so, simply return your transducer to TSI; for a nominal fee it will be recalibrated and returned to you with a certificate of calibration and NBS traceability. Our standard policy is to complete repairs and recalibrations within five business days. This 'annual checkup' assures you of consistently accurate readings; it is especially important in applications where documented calibration schedules must be maintained. ■

Chapter 5

Troubleshooting

Table 2 lists the symptoms, possible causes, and recommended solutions for common problems encountered with the velocity transducer. If your symptom is not listed, or if none of the solutions solves your problem, please contact TSI.

TABLE 2. Troubleshooting the transducer

Symptom	Possible Causes	Solution
There is no output or the output is abnormally low.	The transducer is not powered properly.	Check for a minimum of 11.15 volts at the power-input terminals of the transducer. Check the transducer cabling for proper wiring. Tighten any loose connections.
	The probe is not in the flow stream.	(1) Check that the sensor is properly located in the flow stream. (2) For Models 8460/8470, make sure the sensor is fully extended beyond the end of the shield. (Be careful when installing the probe: make sure it does not strike any surface or damage will result.)
The accuracy of the flow readings is suspect.	The sensor is contaminated.	*Be sure to switch off the transducer before cleaning.* Check for dirt, dust, and/or fibrous build-up on the sensors. Clean the sensors with a soft-bristled brush dipped in water, acetone, or other solvent (fig. 15).
	The sensor is damaged.	Check that the sensor tip is straight and clean; check for a bright metallic color: a darkened or bluish sensor generally indicates excessive overheating. If the sensor is damaged, replace it.

(continued)

TABLE 2. Troubleshooting the transducer (continued)

Symptom	Possible Causes	Solution
With no flow, the sensor does not read zero.	The sensor is contaminated or damaged.	See previous solution.
	The probe is responding to room air currents.	For the Model 8450, wrap paper around the end of the probe to eliminate slight air movement. For the Model 8460/8470, take the zero reading with the probe inside its protective shield. Do *not* operate the sensor in the zero-test mode for longer than 10 minutes at a time. Heat build-up around the sensor may cause a permanent output shift.

Appendix

Mass Velocity: Standard Velocity vs. Actual Velocity

TSI air velocity transducers are thermal anemometers that measure the mass velocity of air flowing past a sensor. Mass velocity is a standard means of indicating air velocity with reference to specific ambient temperature (70°F or 21.1°C) and pressure (14.7 pounds of force per square inch absolute or 760 millimeters of mercury). Since TSI transducers automatically correct for changes in air density caused by fluctuations in ambient temperature and pressure, you are provided with a consistent indication of standard velocity. Standard velocity is the velocity of the air at standard conditions: 70°F and 14.7 psia. Because actual air density is rarely equal to air density at standard conditions, actual velocity usually differs from standard velocity.

In some instances, actual air velocity rather than standard mass velocity may be of interest. To obtain the value for actual velocity, multiply your mass velocity readings by a density correction factor:

$$\text{Actual velocity} = \text{transducer reading (mass velocity)} \times (14.7/530) \times [(470 + T)/P]$$

where T = ambient temperature (in °F)
P = ambient pressure (in psia)

or,

$$\text{Actual velocity} = \text{transducer reading (mass velocity)} \times (760/294.25) \times [(273.15 + T_1)/P_1]$$

where T_1 = ambient temperature (in °C)
P_1 = ambient pressure (in mm Hg).

Example No. 1

You want to measure the actual velocity in a duct. The air temperature in the duct is 55°F and the pressure is 14.25 psia. The transducer readout is 1200 standard feet per minute (SFPM). Thus:

$$\text{Actual velocity} = 1200 \times (14.7/530) \times [(460 + 55)/14.25]$$
$$= 1202.86 \text{ fpm}$$

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